

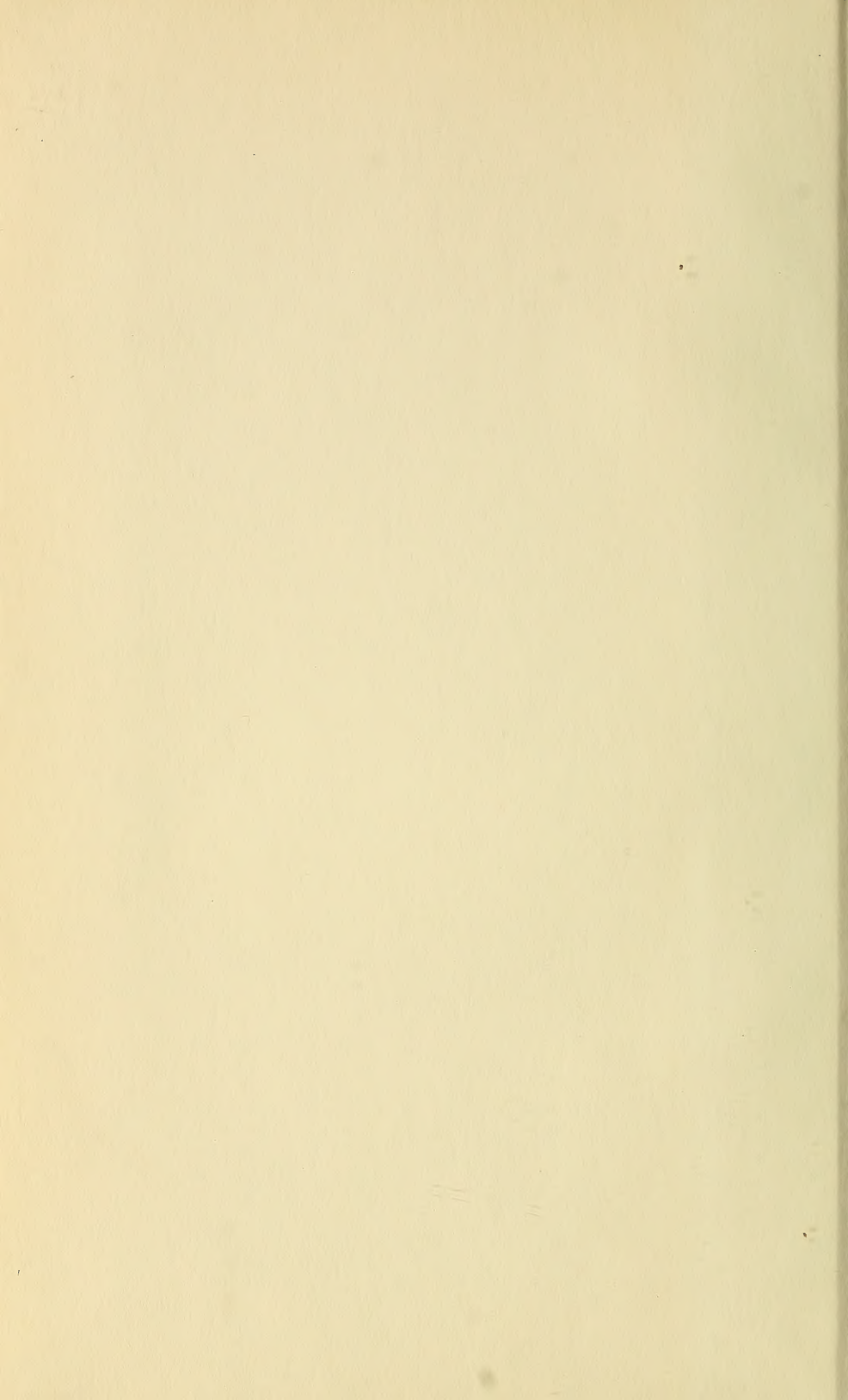
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BULLETIN
OF THE
NEW YORK STATE MUSEUM
OF
NATURAL HISTORY.

Vol. 1.

No. 6.

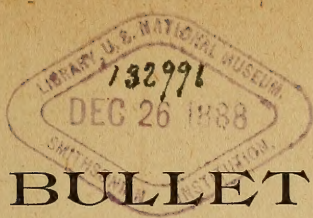
November, 1888.

CUT-WORMS,

By J. A. LINTNER, Ph. D.,
STATE ENTOMOLOGIST.

PRINTED FOR THE MUSEUM.

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CUT-WORMS.

Ever since insect injuries were first talked of and written about in this country, much has been heard of the *Cut-worm*. Its literature, if collected, would probably be as voluminous as that of the Rocky Mountain Locust, *Caloptenus spretus*, a portion of which fills two thick octavo volumes, and a part of a third, of the U. S. Entomological Commission Reports; while the losses resulting from cut-worms, repeated as they are in each successive year, and occurring alike in every portion of the United States, would doubtless exceed those of the above-named insect. Despite the important role they play in agricultural affairs, they are permitted to prosecute their work steadily and persistently, almost unknown, many of them unnamed, and never attaining to the distinguished honor of being made the subject of discussion in a conclave of governors,† or the objects of investigation of a United States Government Commission.



FIG. 1. — The White Grub of *LACHNOSTERNA FUSCA* (Frohl.).

True, more has been charged upon cut-worms than properly belongs to them. The secret manner in which they prosecute their work — under cover of darkness, and often beneath the surface of the ground — rarely permits them to be detected in their opera-

*At a conference of the Executives of the States and Territories suffering most from Locust ravages, held at Omaha, Nebraska, on October 25 and 26, 1876, the following were in attendance: Gov. Jno. S Pillsbury, of Minnesota; Gov. Samuel Kirkwood, of Iowa; Gov. Thomas A. Osborne, of Kansas; Gov. Silas Garber, of Nebraska; Ex-Gov. Robt. W. Furnas, of Nebraska; Gov. John L. Pennington, of Dakota; Gov. C. H. Hardin, of Missouri; and Prof. C. V. Riley and Prof. Cyrus Thomas, of the U. S. Entomological Commission.

tions, or the injuries inflicted to be unmistakably referred to them.

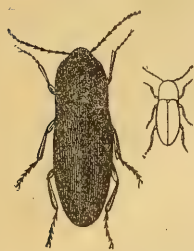


FIG. 2.—The Truncated snapping-beetle, natural size and enlarged.

Roots are eaten and young blades and shoots are cut off, and the unknown depredator, as an easy solution of the mystery, is pronounced a cut-worm. Often in these cases, if proper examination were made, it would be found to



FIG. 3.—The common snapping-beetle, *MELANOTUS COMMUNIS* (Gyll.).

proceed from the white grub, *Lachnosterna fusca*, shown in Fig. 1, or one of its many allied forms, or from some species of wire-worm—the larvæ of the “snapping beetles” belonging to the family of *Elateridæ* (two of



FIG. 4.—The W-marked cut-worm of *AGROTIS CLANDESTINA* (Harris).

the beetles are represented in Figs.



FIG. 5.—Wire-worm of Truncated snapping-beetle.

2 and 3). Such mistakes should not occur; they are inexcusable. Careful search would rarely, if ever, fail to bring to the light of day the author of these injuries; and when found, certainly after all that has been written and figured and gratuitously distributed upon entomological matters, every intelligent tiller of the soil in which these creatures lurk, should be able to distinguish between a white grub (Fig. 1), a cut-worm (Fig. 4), a wire-worm (Figs. 5 and 6), and a thousand-legged worm (Figs. 7 and 8)—the latter not even a true insect. Until this can be done, inquiry should not be made of



FIG. 6.—The common wire-worm. (After Fitch.)

how to destroy “the cut-worm,” for the reply would be but a random shot fired in darkness.

WHAT ARE CUT-WORMS?

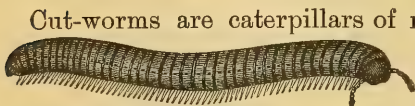


FIG. 7.—Thousand-legged worm, *JULUS MULTISTRIATUS* Walsh.

Cut-worms are caterpillars of moths that belong to the great family of *Noctuidæ*, which embraces a large proportion of our night-flying species of *Lepidoptera*. There are many different

species—how many we are not able to state even approximately—

as the larvæ of very few of the mature forms (the moths) contained in the genera of *Agrotis*, *Mamestra*, and *Hadena*, to which they mainly pertain, have as yet been ascertained. About 350 United States species have been described in these three genera—*Agrotis*, embracing the larger number, and pre-eminently the Cut-worm genus. Of some of these, their habits are not such as entitle them to be numbered among the Cut-worms proper. We would prefer limiting this designation to forms having the appearance and habits of those known to English writers and agriculturists as *surface caterpillars*, and not extending it to those which seek their food mainly in trees or tall plants. Under such a limitation the class can be somewhat definitely circumscribed.



FIG. 8.—Thousand-legged worm—position at rest, and young

THEIR APPEARANCE.

The following are the principal features of the typical Cut-worms, by the aid of which it will not be difficult to recognize them :

When full grown, they measure from an inch and a quarter to nearly two inches in length. They are sixteen-footed (three pairs of true legs and five pairs of pro-legs or prop-legs), thick, tapering moderately at the extremities, naked and greasy-looking. In color they are dingy brown, gray or greenish, with indistinct, light and dark, longitudinal markings, and occasionally some



FIG. 9.—The Glassy Cut-worm, *HADENA DEVASTATRIX* (Brace).

oblique lines. The head is large, shining and usually red or brown. On the top of the first segment, or ring, is a horny plate, called "the collar" or cervical shield, and on the last, another smaller one, known as the anal plate, both of a shining and darker color than the rest of the body. On each of the segments are six or eight small, blackish humps or dots, each bearing a short hair, as shown in an enlargement of a segment in Fig. 9. When the caterpillar is taken from the ground, or otherwise disturbed, it curls itself into a ring, as represented in Fig. 4, or even more closely than this, with its head resting on its anterior prolegs, and the anal pair upon the crown of the first segment.

THEIR HABITS.

They are nocturnal in their habits, passing the day in concealment, in holes made by them in the ground among or near the roots of their food-plants, or in other shelter beneath stones, sticks, rails, decomposing leaves and grass, etc. A few of the subterranean species rarely if ever come to the surface, but cut off the tender blades beneath the ground, drawing them in as they are consumed or bearing the excised portion to their retreats to feed upon at leisure. Most of them, however, come forth from the ground after dark (sometimes by day in cloudy and damp weather), and with appetites sharpened by a protracted fast, make vigorous attack upon the young annual plants of the garden or the field, feeding upon their tips, or severing their stalks and destroying far more than they consume. If, during the time of their abundance, search be made for them at night with the aid of a lantern, hundreds of them may be discovered busily occupied in their destructive work. At the approach of day they retire to their hiding places, which may frequently be detected by the hole near the plant, made by them in reëntering the ground.

The time of their greatest injuries is when they are nearly full-grown, in the months of May and June.

Guenée, in his *Histoire Naturelle des Insectes—Species Général des Lépidoptères*, vol. v—Noctuelites, i, p. 258, has remarked as follows, upon the appearance and habits of the larvæ of the genus *Agrotis*:

Smooth, thick, with transparent skin and of dirty colors, furnished with elevated, shining trapezoidal spots, with the plates of the collar and the anus equally shining, and of a horny consistency they resemble worms or larvæ of insects far removed from the Lepidoptera. Their manner of living is not less marked. They do not confine themselves to hiding during the day under low plants; but they bury literally in the earth and among their roots, and when night arrives they do not often leave their tomb, except by projecting so much of the anterior portion of their body as is necessary to grasp their food. Several of the species are very destructive, especially by reason of their abundance, as *exclamationis*, *segetum*, *valligera*, *tritici*, *aquilina*, *obelisca*, etc. Their ravages are, however, less serious, by the fact that they usually attack the low plants, as *Plantago*, *Rumex*, *Taraxacum*, and the useless Gramineæ. Nevertheless, they are very dangerous guests of the gardens; it seems, even, that under certain circumstances they attack plants of very different families, and are not opposed to mounting during the night upon woody vegetation

M. Treitschke speaks of the ravages caused in 1833 and 1834, in the vineyards in the environs of Vienna by caterpillars of *aquilina*, which devoured the leaves, the blossoms and the buds, and I have myself seen roses attacked by the caterpillar of *segetum*.

HABITS OF THE MOTHS.

Most of them are nocturnal. A few species fly by day and may be found during the autumnal months feeding upon the nectar of flowers, as upon those of the golden-rod (*Solidago*). But by far the larger number come abroad only at night to feed, passing the day, in sleep probably, in various hiding places, as in crevices of walls, piles of wood and stone, under the bark of trees, behind closed blinds of dwellings where they have been attracted during the evening by lights—in short, in any dark, secluded place or crevice into which their closely-folded wings permit them to creep. Their entrance into crevices or apertures apparently too small for their admission, is facilitated by the habit belonging to many of the species of folding their front wings one over the other by the overlapping of their inner margin, and holding them almost parallel to the plane of position. In this attitude the greatest breadth of the moth across the folded wings exceeds but little the diameter of the body.



FIG. 10.—*AGROTIS SUBGOTHICA*, the Gothic Dart-Moth. (After Fitch.)

of folding their front wings one over the other by the overlapping of their inner margin, and holding them almost parallel to the plane of position. In this attitude the greatest breadth of the moth across the folded wings exceeds but little the diameter of the body.

Although strongly muscular in their build, and capable of vigorous flight, when driven up from their concealment they fly but a short distance before they alight and seek a hiding place—much after the manner of the *Hesperidae* among the butterflies, commonly known as “skippers.” Fig. 10 shows one of the common species, the Gothic Dart-Moth, *Agrotis subgothica* (Haworth).

NATURAL HISTORY.

From the differences observed in the species known to us, it is not possible to give a satisfactory account of the life-history of cut-worms as a class. They require to be separately discussed. It may be stated, however, that the eggs from which the caterpillars proceed are placed usually upon some low plant, whence the young when hatched may easily reach the food that they require. It was formerly supposed, by Kollar and others, that the eggs were laid in the ground, but we are not aware of any

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reliable testimony of their having been found in such places,

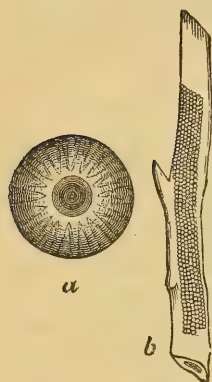


FIG. 11.—*a*, egg of *AGROTIS SAUCIA*, greatly enlarged; *b*, eggs of the same deposited upon a twig, natural size.

while of some species the eggs have been discovered in locations quite removed from their natural food-plants, as upon the leaves and twigs of trees not known to be frequented by the larvæ, as are, at times, the eggs of *Agrotis saucia* (Hubn.), as shown in Fig. 11. The usual time for egg-deposit is the latter part of summer. Hatching soon after, early in the autumn, the larvæ enter the earth and commence to feed upon the tender roots of various plants—upon almost any kind that they encounter, as at this stage of their life they are very general feeders. At the commencement of winter as the frosts penetrate to their abode and chill them, and they have become about half grown, they descend into the ground to the depth of six or eight inches or even not so deep. Here they shape for themselves an oval cavity, within which they curl up in a torpid state for their winter's sleep. Freezing fails to harm them if undisturbed in their retreats. In the spring, when the frost leaves the ground, they awaken to activity, ascend to near the surface, and resume their feeding upon the roots of the starting vegetation. With their rapid growth, they soon attain to the size and strength that permits them to travel through the ground with ease in search of the particular food most agreeable to them.

When full-grown they again descend into the ground to a greater depth than before, and within a compacted cell, made by packing the earth with their head, after the few days required to produce the change, throw off the caterpillar skin and become smooth, dark-brown pupæ. The pupal stage may average three or four weeks, when the moth issues from the rent pupal case and makes its way to the surface. During the brief life of the winged insect, which lasts only for two or three weeks, if not sooner terminated by one of its many enemies, the sexes come together, eggs are deposited for another brood, a moderate amount of food is partaken of in the nectar of flowers or other sweet substance, and the life-cycle is completed. A similar round, only much shortened in duration, and with continued progress, in some cases follows and is completed during the summer, but as a rule only a single brood of cut-worms is produced during the year.

In some of the species—in *Mamestra trifolii* (Rott.) and others, the life-history, as above given, differs, in that the hibernation is not in the larval stage, but as a pupa. The larvæ complete their growth in the autumn and enter upon the pupal stage in October and November. The moths of these species are those which are the first to appear abroad in the spring. [*Mamestra trifolii* is illustrated in Fig. 12, in three of its stages.]

CONDITIONS FAVORABLE TO CUT-WORMS.

The abundance of cut-worms is not dependent upon, or materially influenced by, the character of the soil. They are known to occur alike in gravelly soil, in

loam, in clay, in sand, upon uplands and in alluvial bottoms. Their number does not appear to be increased by a high degree of fertility, for a cold and sterile location serves them as well, so long as it provides them with the requisite food-supply. Dr. Fitch states that he never found them more plenty than on one occasion among beans planted upon a hill-side, so barren that it was thought nothing else could be raised thereon. Nor does the kind of manure applied to the land seem to have any influence, except as it induces a more succulent plant-growth. A writer states, that he finds them more numerous on dry rolling ground. That this may not be accepted as the rule, appears from the statement of another, who says, "it has been observed that they damage crops more especially on wet lands," and he therefore recommends draining as a remedy.

With some of our insect pests, soil-conditions and character have much to do. Thus, we have recent evidence to lead us to believe that the rose-bug, *Macrodactylus subspinosus* breeds in wet, sandy land, and that a clayey soil is almost a preventive of its ravages. But with the ubiquitous cut-worm the soil is a matter of indifference—the vegetation that it bears, all-important. The

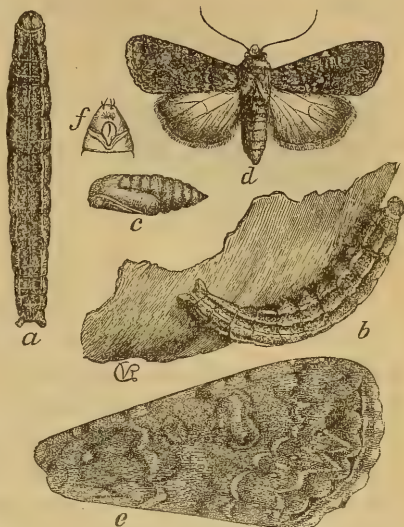


FIG. 12.—*MAMESTRA TRIFOLII*; *a* and *b*, the Clover Cut-worm; *c*, pupa; *d*, moth; *e*, enlarged wing of the same; *f*, anal segment of the pupa.

parent moth, with provident instinct, selects the locality for the deposit of its eggs that offers the most desirable food for its rapacious progeny.

Experience dearly bought, has taught us the food that they prefer, and its attendant conditions. A corn-field upon a newly turned sod is the metropolis of the cut-worm, while corn upon clover stubble, oat stubble, and wheat stubble, are places where they love to congregate.

THEIR FOOD-PLANTS.

In treating of so large a group of insects, and especially, one in which the several species are almost indiscriminate in their tastes, it can serve no useful purpose to present a list of all their known food-plants. A reference to such as suffer the most severely from their depredations, will be sufficient for the present paper.

Grass.—The amount of injury to grass lands from cut-worms, can only be conjectural, associated as it usually is with those of the white grub and allied species, wire-worms, the larvæ of the *Tipulidæ* or crane-flies, and of numerous other insects. It is, however, very great, for the first half of the active life of many of the species, is believed to be largely sustained by the food found in the roots of the various grasses — only taking upon themselves the true cut-worm habit when the coming of the young corn, cabbage, and tender garden vegetable invites, after their winter's rest, their greedy and wasteful attack. The extent to which they infest grass lands, is shown in the well-known experience that rarely if ever, is cut-worm attack so serious and so noticeable, as when corn is planted upon a newly-broken-up sod.

Corn.—The fondness of the cut-worm for corn, the most succulent of our grasses, has become proverbial; hence we have the following old distich giving the number of kernels to be planted in a hill:

“One for the black-bird and one for the crow,
Two for the cut-worm and three to grow.”

Rarely is a corn-field exempt from its presence. Resulting at times only in a permissible, and perhaps, desirable thinning, yet frequently it compels an entire replanting. The extent of its injuries in some instances will be mentioned hereafter.

The following species, among others, are recorded as preying upon corn: *Agrotis clandestina*, *A. c-nigrum*, *A. subgothica*, *A.*

herilis, *A. messoria*, *A. saucia*, *A. tessellata*, *A. ypsilon*, *Hadena arctica*, *H. devastatrix*, *Laphygma frugiperda*, and *Nephelodes violans*. [Of these, *Agrotis clandestina* and *Hadena devastatrix*,



two of the most common of the Cut-worm moths, and the most destructive to corn, are shown in Figs.



FIG. 13.—*AGROTIS CLANDESTINA*. 13 and 14.]

FIG. 14.—*HADENA DEVASTATRIX*.

Wheat.—Wheat is often injured to a serious extent by a species for a long time only known to us as a dingy-brown larva, with a conspicuous yellowish-gray band upon its sides. In several localities its attack had only been observed in instances where the wheat had been sown upon oat stubble (*American Entomologist*, i, 1868, p. 59). The larva was subsequently ascertained by breeding it, to be that of *Laphygma frugiperda*. Professor Riley had described it as the Wheat Cut-worm, in his first Missouri report. At the present time it is more generally known as the Army Cut-worm, from the abundance in which it at times occurs. For representation of the moth, see page 20, Fig. 23.

The European wheat fields often suffer enormously from two species, viz.: *Agrotis tritici*, the wheat dart-moth, and *Agrotis segetum*, the common dart-moth, which feed upon both the roots and leaves of winter wheat.

Barley.—A cut-worm, identified as *Agrotis declarata* Walker, caused considerable injury to barley fields (to oats also), in Manitoba, during the month of July of the year 1884. (Saunders, *Canad. Entomol.*, xvi, 1884, p. 206.) It is described as grayish-brown, with a semi-transparent skin, a brown horny head, and a shield of the same character on the upper part of the second segment; a pale line down the back, two similar lines along each side, and a white band lower down, close to the under surface.

Cabbage.—In a garden in Normal, Ill., containing 600 young plants, not over thirty escaped. The larvæ came out of the ground (in the middle of April), and cut off the plants at or near the surface, and then ate the leaves. The owner killed about 200 of the worms on the first day of their appearance, and 500 or more on the day following, after which the plot was reset with

late ca^l-bages. The cut-worm was found to be *Agrotis annexa* (Treits.), shown in Fig. 15, in its three stages of larva, pupa and moth. (Forbes, *Twelfth Report of the Insects of Illinois*, 1883, p. 103.)

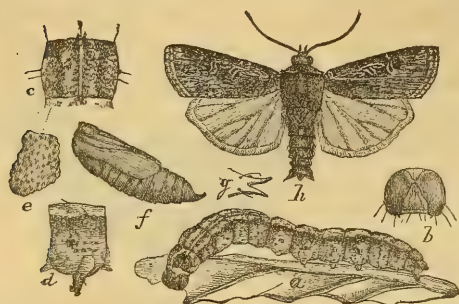


FIG. 15.—The Cabbage Cut-worm, *AGROTIS ANNEXA*: a, larva feeding; b, head; c, d, dorsal and lateral views of a middle joint, enlarged; e, fate. At least 500 worms were taken and killed from the cabbage plot, leaving them still numerous. (*Country Gentleman*, June 24, 1875, p. 392.)

In another locality, of 500 cabbage plants and 300 tomato plants set out a week later, but about 200 of each had escaped the cut-worm. A resetting shared the same fate. At least 500 worms were taken and killed from the cabbage plot, leaving them still numerous. (*Country Gentleman*, June 24, 1875, p. 392.)

A writer, inquiring for a remedy for the cut-worm so destructive to young cabbage plants, states incidentally, that *one-half* or more of the young plants are cut down in early spring, especially if the nights following their setting are cool or damp.

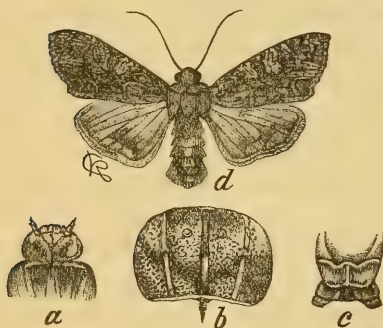


FIG. 16.—*MAMESTRA SUBJUNCTA*: a, head and collar; b, a middle joint; c, the anal shield; d, the moth.

Mamestra subjuncta (Gr.-Rob.), is illustrated in Figure 16, as one of the most injurious of the species to cabbage.

Turnips.—A favorite method of attack upon the turnip is to eat into and around the neck of the plant, until it is detached, or to eat off separate leaves and drag them into the hole beside the plant to feed upon during the daytime. The turnip crop in England is more liable to cut-worm attack than is the crop in our country, the principal depredators being *Agrotis exclamationis* Linn., *Agrotis segetum* Ochs., *Mamestra brassicæ* Linn., and *Triphaena pronuba* (Linn.).

Of the species preying upon cabbage are: *Agrotis clandestina*, *A. saucia*, *A. annexa*, *A. messoria*, *A. malefida*, *A. ypsilon*, *Mamestra subjuncta*, *Mamestra trifolii*, *Hadena devastatrix* and *Laphygma frugiperda*.

Onions.—Upon four acres of ground in Chautauqua Co., N. Y., onions had been cultivated for sixty years. In one of these years, the plot was sown and weeded out the second time, all standing well. The cut-worms commenced their work, and notwithstanding bushels of them were killed they cut off every onion, and on the fourth of July the land was plowed up for another crop.

Probably the most severe attack upon onions is that which was reported from Goshen, Orange Co., N. Y., early in June of 1885. A cut-worm was found to be rapidly destroying the crop, and to threaten the extinction in that vicinity of an industry, the annual value of which was stated to be half a million of dollars.

The attack was investigated by the Entomological Division of the Department of Agriculture, and the insect engaged in it ascertained to be the "Dark-sided Cut-worm" *Agrotis messoria* Harris, represented in Figure 17,

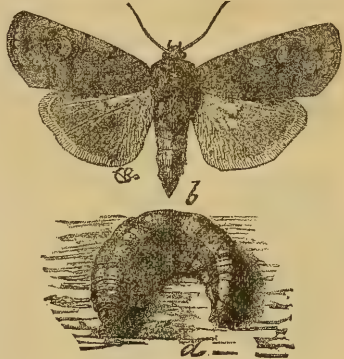


FIG. 17.—*AGROTIS MESSORIA*: the larva and moth.

together with the moth that it produces. So abundantly did the worm occur, that according to the report of Mr. J. B. Smith made to the Department, "three little girls had picked in the morning a three-quart pail full. In one spot, less than fifteen inches square, forty full-grown larvæ were taken." In another report it is stated: "It is common for a family to pick ten or twelve quarts by day, and the same number at night by the light of lamps. These most industrious people have to work day and night to keep down these pests and save their crops." (See Professor Riley's Report in the *Ann. Rept. Commis. Agricul.*, for 1885, pp. 270–275.)

The crop in this locality suffered also severely from the above attack the following year (1886). The usual annual yield of the onion fields of Orange county, of from 500,000 to 600,000 bushels, was, it is estimated, reduced one-half (*Country Gentleman* for October 7, 1886, p. 750).

Beans.—The tender stems of young beans furnish tempting food, and every gardener knows the frequency with which the young plants are found in mornings with the stem severed in such a manner, as to leave no doubt of the presence of the cut-worm. The W-marked Cut-worm, *Agrotis clandestina* (Harris), is a common

depredator upon this plant. Dr. Fitch also describes the "Black-headed Cut-worm" as very destructive to beans, cutting them off slightly below the surface, and dragging the severed stem into the ground, where it buries itself, and there feeding upon it during the day, till the whole is devoured, or only pieces of the wilted leaves remain, plugging up the entrance to the hole (*First and Second Reports Ins. N. Y.*, p. 313).

Strawberries.—Mr. Wm. Saunders reports a severe attack of a

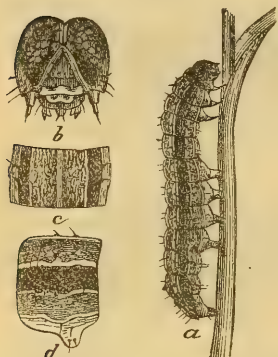


FIG. 18.—The Army Cut-worm, *LAPHYGMA FRUGIPERDA*, with enlargements of head and a segment.

species of *Agrotis*—the particular species is not named, although a full description of the larva and a brief one of the moth are given—upon plantations on the borders of Lake Huron, near Sarnia. The caterpillars manifested an especial fondness for the foliage of the strawberry, and notwithstanding the most vigilant search for them night after night, after they had been discovered as the depredators, and the collection and destruction of large numbers of them, they defoliated large patches of the vines to such an extent that they were utterly ruined. Nearly all through the month of June they literally swarmed, and scarcely a night passed without material damage from them. In one night, 1,800 of the caterpillars were killed by Mr. Mounjoy upon his beds (*Second Annual Report of the Entomological Society of Ontario*, for 1872, pp. 21, 22).

Agrotis fennica, at an early stage in its phenomenal appearance in the spring of 1884, while but one-half inch in length, was found

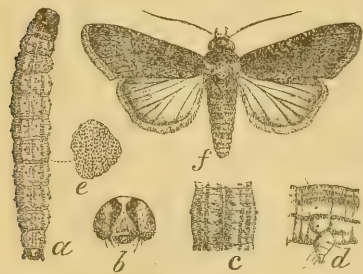


FIG. 19.—*AGROTIS MALEFIDA*: a, larva; b, its head enlarged; c, d, dorsal and lateral views of a middle joint; e, highly enlarged surface of skin; f, the moth.

in Canada, by Mr. James Fletcher in large numbers, beneath strawberry plants, upon which they were feeding.

In the Southern States, *Laphygma frugiperda* (Sm.-Abb.), known there as the "Grass worm," has been injurious to strawberries (*Rept. Comm. Agricul.* for 1882, p. 138). It is shown in Figure 18.

Hops.—The operations of different cut-worms have frequently been observed on hop-vines, and they have

been turned up in the ground about the plants. So far as we know, but one of the species has been identified. It was found by Mr. Bennett, at Newton, N. J., feeding destructively on his vines and those of his neighbors. Sent to the Division of Entomology at Washington, it was ascertained to be *Agrotis malefida* Guen. — a species which is of more common occurrence in the Southern States than to the northward. In this instance, its injuries were arrested by dusting the vines with a powder made of gas-tar and lime. (*Bull. No. 11. Divis. of Entomol.—U. S. Dept. Agricul.*, 1886, p. 31.)

This cut-worm has also been found to be injurious to cabbage, and to a number of other plants. It is illustrated in Fig. 19.

Tobacco.—Young tobacco plants are often cut off in the month of June. In West Meriden, Conn., three thousand plants were set on June 22d. The next morning, from one row of one hundred and eighty plants two hundred and fourteen cut-worms were taken. Dr. Fitch records the fact of their particular fondness for this plant. He states: "I set out in my garden a few tobacco plants that I might notice what insects would come upon this filthy weed; and within a few days after, one of these cut-worms gave me a very palpable reminder that he would not tax me for cabbages and beans if I would only furnish him with what tobacco he wanted to chew" (*Sixth-Ninth Reports Ins. N. Y.*, 1865, p. 243).

Figure 20 shows "the Black Cut-worm," and the moth that it produces, *Agrotis ypsilon* (Rott.), which is one of the species from the attack of which tobacco plants are known to have received severe damage.

Clover.—In the Ottawa district of Ontario, during the month of May, 1884, a cut-worm was discovered in large numbers and proving very injurious in clover fields. It was at first believed to be the army-worm, but upon rearing some of them to the perfect state, they proved to be *Agrotis fennica* (Tausch.) (Saunders, *Canad. Entomol.*, xvi, p. 204). *Agrotis malefida* Guen., also feeds on clover (Riley in *Rept. to Comm. Agricul.* for 1884, p. 292).

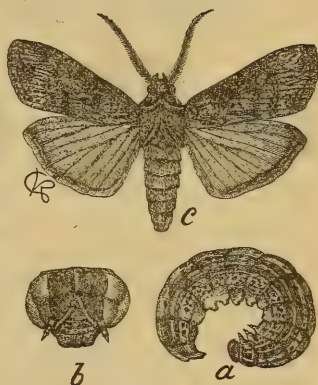


Fig. 20.—*AGROTIS YPSILON*: a, larva; b, enlarged head of same; c, the moth.

Cotton.—Early cotton—February planted, is frequently damaged by different species of cut-worms, particularly by the Cabbage Cut-worm, *Agrotis annexa* (Treits.). (*Bulletin* No. 1, *Dept. Agricul.—Div. Entomol.*, 1883, p. 44.) *Laphygma frugiperda* (Sm.—Abb.) is also injurious to cotton, according to Glover, who has illustrated the insect in its different stages, and its earthen cocoon, in plate 9 of his MS. Notes—Cotton, under the name of the “Grass worm.”

Smilax.—This beautiful and delicate twiner, *Myrsiphyllum asparagoides*, has been injured by the Variegated Cut-worm, *Agrotis saucia* (Hüb.), which has attacked it in conservatories in Lowell, Mass., and eaten off the softer parts and especially the top of the plant (*American Entomologist*, 1880, iii, p. 298).

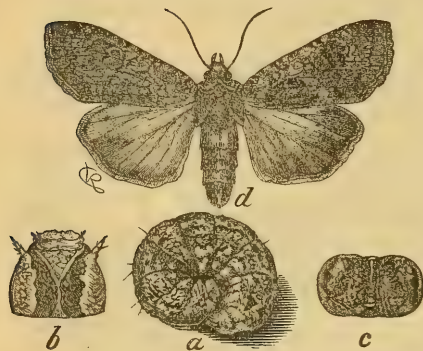


FIG. 21.—*AGROTIS SAUCIA*—*a*, larva; *b* and *c*, head and a middle joint of the same, enlarged; *d*, the moth.

The worm and its moth are represented in Fig. 21. It is one of our commonest cut-worms, which is ever ready to attack almost any kind of tender vegetation, and has often been known to climb vines and feed upon their foliage. The moth was for a long time known as *Agrotis inermis* Harris, but later was ascertained to be identical with the *A. saucia* (Hüb.), of Europe.

Flowers.—In a bed of hyacinths, at Buffalo, N. Y., just as the flower buds had commenced to open, the flower-scapes were cut off—hardly one in five remaining.

Mr. William Saunders has noticed a special fondness of cut-worms for pansies. “Many fine plants of this flower of the previous year’s growth were found, early in the season, eaten close to the ground, both leaves and stalks, and from about the roots of a single plant from thirty to fifty of the nearly full-grown larvæ were taken (*Canadian Entomologist*, 1880, xii, p. 189).

A gentleman writing for a cut-worm remedy, from Greenwich, R. I., states that nasturtiums, phlox, and carnations had suffered severely. Dr. Harris mentions asters, balsams, and pinks as often shorn of their leaves and of their central buds by these concealed spoilers (*Ins. Inj. Veg.*, p. 443).

Some beds of phlox bordering a carriage-way in New Jersey,

were found by Mrs. Mary Treat very attractive to cut-worms. "Untold numbers" were discovered feeding upon them when examined with a light in the evening, and upon turning over some of the ground beneath them, in one search over a pint of the worms were taken, from just beneath the surface (*Proc. N. J. St. Horticult. Soc.*, at 8th Meeting, 1883, pp. 88-9).

Among other garden and field crops which are liable to cut-worm attack, are peas, beets, potatoes, tomatoes, pumpkins, melons, and squashes.

ABUNDANCE OF CUT-WORMS.

As with other insects, these have their years of unusual abundance, for which we are not able to assign a satisfactory cause. Sometimes a single species only has multiplied, and one that had never before been known as injurious, as with the Bronze-colored Cut-worm, *Nephelodes violans*, in Northern New York, in the spring of 1881, and with the recent phenomenal appearance of the hitherto rare *Agrotis fennica*, in Northern Michigan and in Canada, in 1884. At other times all of the well-known species make their appearance in such force that it is next to impossible to interpose effectual resistance against their onslaught.

A few instances of their occasional abundance may be cited :

More than thirty cut-worms have been found around one hill of cucumbers.

In Sullivan county, Tenn., as many as sixty have been dug from a single hill of corn (*Report Commis. Agricul. for 1872*, p. 122).

"Bushels," are reported as having been taken from a large onion field.

Dr. Harris copies the statement without questioning it, although seeming almost incredible, that sixty bushels of mold taken from a buckwheat field where *Agrotis tritici* prevailed, contained twenty-three bushels of the caterpillars.

LITERATURE OF THE CUT-WORMS.

Dr. Harris, in the first edition of his admirable report, published in 1841, and entitled "A Report on the Insects of Massachusetts Injurious to Vegetation," prefaces his discussion of cut-worms, occupying fourteen pages, with this brief summary of the general ignorance of them at the time of his writing: "Numerous complaints have been made of the ravages of cut-worms among corn, wheat, grass, and other vegetables in various parts of the country.

After a tiresome search through many of our agricultural publications, I have become convinced that these insects and their history are not yet known to some of the very persons who are said to have suffered from their depredations."

Dr. Harris has given briefly their general habits, and refers them to the group of Noctuid moths known as *Agrotidians*, of which he presents the prominent features and characteristics. From a considerable number of cut-worms collected by him during the months of June and July, scarcely differing in appearance from one another, five different species of moths were obtained. One of these was the *Agrotis devastator* of Brace, and the other four were described and named by him as *Agrotis telifera*, *Agrotis inermis*, *Agrotis messoria* and *Agrotis tessellata*; of these the first two have since been found to be identical with *Agrotis ypsilon* Rott. and *Agrotis saucia* Engr. Quoting from letters of Dr. F. E. Melsheimer upon the "Corn Cut-worm," he gives additional observations of his own upon it, and names it *Noctua clandestina*. Several remedies for these pests are proposed and quoted from other writers. Another species, which cuts off the leaves of roses, currant bushes, and other shrubs and even young trees, is referred to *Hadena amica*, described by Stephens, as rare in England, but which had been previously described by Dr. Boisduval as *Hadena arctica*.

In the *Second Report on the Insects of New York* (Trans. N. Y. State Agricultural Society for 1855, xv, pp. 542-550, and pp. 310-318 of the First and Second Reports, published in 1856), Dr. Fitch treats of the cut-worms — "the larvæ of different species of *Agrotis* that sever the young stalks of Indian corn by night at or near the surface of the ground." The moths that they severally produce were still unknown, as no success had attended the efforts to rear the larvæ in confinement. Five kinds had been observed by him preying upon corn, which he briefly describes, with their habits, under the names of the Red-headed Cut-worm (cutting the plants below the surface of the ground), the Striped Cut-worm (cutting the plants half an inch above the ground), the Faintly-lined Cut-worm (more common among onions and cabbages), the White Cut-worm (rare among corn and beans), and the Black-headed Cut-worm (destructive to beans, cutting them below the surface and drawing the severed stem into its hole). Three species of Cut-worm Moths are also described, figured and their habits given, viz.;

Agrotis subgothica (see Figure 10), *Agrotis devastator* (a *Hadena* Figure 14), and *Noctua clandestina* (an *Agrotis*, Figure 13). As natural enemies of the cut-worm, the crow, the larva of one of the ground beetles — *Harpalus caliginosus* (see Figure 26, p. 25), and a hymenopterous insect like the black wasp, are mentioned. Useful preventives and remedies are thick planting, digging out by hand, and trapping in holes.

In Dr. Fitch's *Ninth Report on the Insects of New York* (*Trans. N. Y. State Agricultural Society* for 1863, xxiii, pp. 804-817, and *Sixth to the Ninth Reports*, 1865, pp. 237-250), in connection with general remarks upon cut-worms, the "Corn Cut-worm" is treated of in minute detail of description, habits, etc., under the name of *Agrotis nigricans* var. *maizi*. The species has since been identified as *Agrotis tessellata* Harris. It is represented in Fig. 22, in its natural position at rest, and with wings expanded in flight.



FIG. 22.—Moth of the Striped Cut-worm, *AGROTIS TESSELLATA*. (After Fitch.)

A like minute account of the "Yellow-headed Cut-worm" is given, from which "*Hadena amputatrix*" of the Third report, was reared, now known as *Hadena arctica* Boisdu.

The larva of a common carabid beetle, *Calosoma calidum* (Fabr.), shown in Figure 25, page 24, is also described and figured, as one of the most efficient destroyers of cut-worms. Its method of attacking, killing and devouring its prey is graphically detailed, and characterized as "one of the most interesting and wonderful exhibitions of insect economy which the world affords."

Mr. B. D. Walsh, in the *Practical Entomologist* for June, 1886, i, pp. 85-6, has devoted about two pages to the habits of cut-worms, and notice of four species of *Agrotis* and two of *Hadena*. An account by Mr. Cochran of some climbing cut-worms in Illinois is quoted, and mention made of a species infesting vineyards in California, and causing serious loss by cutting off the stem of the leaf.

On pages 64-66 of vol. ii of the same publication is an article entitled "Do Cut-worms destroy tree-buds?" where the affirmative observations of the writer are given, together with some expedients adopted for the destruction of these creatures.

In the *First Annual Report on the Insects of Missouri*, published in 1869 (pp. 67–91), Prof. Riley adds materially to our knowledge of these insidious depredators, in an article entitled “Cut-worms: The Natural History of Twelve Distinct Species.” Of these, four are described as “climbing cut-worms,” from their habit of ascending trees at night to feed upon the buds and leaves. They have been found abundantly upon apple and pear trees, especially upon the dwarf varieties and upon grapevines, preying upon the buds. They also attack the blackberry, the raspberry, currant, and rose bushes.

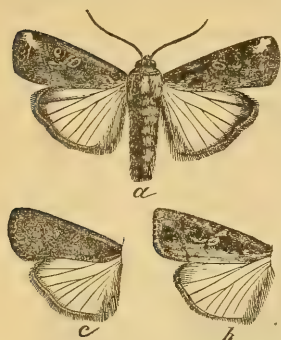


FIG. 23.—*LAPHYGMA FRUGIPERDA* and varieties.

The transformations of ten species are given, together with figures and descriptions of the caterpillar and the moth; and two other species, previously described in their several stages by Dr. Fitch, are referred to. A wheat cut-worm is also described and history given, which subsequently proved to be *Laphygma frugiperda* Guenée. The moth is shown in Figure 23, and its larva in Figure 18. The natural enemies and remedies for these destructive creatures close the notice.

Dr. Packard, in his *Guide to the Study of Insects*, 1869 (pp. 305–310), introduces figures of a few of the more common species, and quotes from the writings of Dr. Harris and Prof. Riley.

In the *Seventh Annual Report on the Insects of Illinois*, published in 1878 by Dr. Cyrus Thomas, Prof. G. H. French presents, in connection with his study of corn insects, a paper of twenty pages (pp. 81–100) upon the Cut-worms of the Field and Garden. Some general remarks upon these insects are followed by mention of natural and artificial remedies and by remarks upon the habits and characteristics of twelve species.

In the same report (pp. 202–219) Prof. French has given a second notice of cut-worms, in which descriptions of the moths of fourteen species appear, and of the larvæ of most of them, together with observations upon the habits, etc., of several of the species made by himself and by Mr. C. E. Worthington, of Chicago, Ill.

In the *Report of the Entomological Society of Ontario* for the year 1879, pp. 37–46, is a paper on “Canadian Cut-worms,” by Mr. G. J. Bowles, of Montreal, in which twelve species are noticed,

described, and habits recorded of some, and remedies given. They are nearly all those which had been previously treated of by Professor Riley.

In an article entitled "Cabbage Cut-worms," contained in the Report of the Entomologist to the Commissioner of Agriculture, for the year 1884, Professor Riley has given a brief account of cut-worms in general, the best approved remedies for them, and excellent notices, averaging over a page each, of eight species that depredate on the cabbage, each of which is finely illustrated, as may be seen from the figures, which, through the kindness of the Commissioner of Agriculture, we have been able to present in the present paper.

The above are, we believe, the principal publications upon cut-worms accessible to the general reader. Reference to several other writings upon those which are injurious to Indian corn, may be found in a paper prepared by Mr. Thomas F. Hunt, and published in *Miscellaneous Essays on Economic Entomology by the State Entomologist of Illinois and his Assistants*, 1886, pp. 64-66.

LIST OF SPECIES.

As previously stated, no approximation to a full list of our cut-worms can as yet be given, since the larval stage and habits of so few of the species of *Agrotis*, *Mamestra*, and *Hadena*, are yet known. It would not be safe to presume, to any extent, upon a genetic identity of habits, since marked differences have been observed. For example, *Agrotis c-nigrum* (Linn.) and *A. bicarnea* (Guen.), according to Mr. S. L. Elliott, have been seen feeding by day, without any concealment, on chicory, *Cichorium intybus*. *Mamestra picta* Harris, the zebra cabbage worm (shown in Figure 24), feeds exposed, in dense clusters, when young, upon several of its food-plants, scattering with age, but continuing to feed by day without

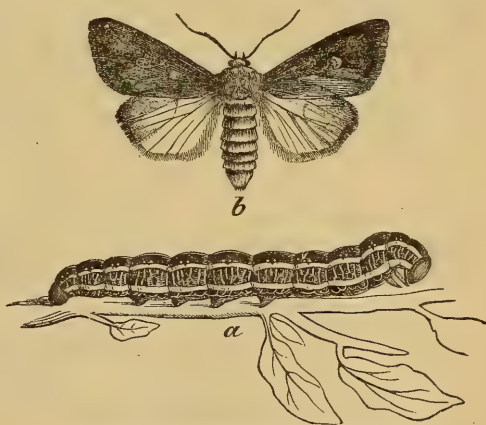


FIG. 24.—*MAMESTRA PICTA* HARRIS.

concealment. *Hadena adjuncta* Boisd., has not cut-worm habits, but finds its food at all hours of the day in the blossoms of the golden-rod (*Solidago*). *Hadena turbulenta* (Hüb.) feeds socially on *Smilax* at times, so abundantly as to defoliate it.

The following are the species of cut-worms, so far as known to me (twenty-eight in number), occurring in the State of New York:

The Spotted Cut-worm.....	Agrotis	c-nigrum (Linn.).
	A.	bicarnea (Guen.).
The Streaked Cut-worm	A.	haruspica Grote.
	A.	baja (S. V.).
The Black-lined Cut-worm.....	A.	fennica (Tausch.).
The Dingy Cut-worm.....	A.	subgothica (Haw.).
	A.	tricolor Lintn.
The Western Striped Cut-worm.....	A.	herilis Grote.
The White-headed Cut-worm	A.	plecta (Linn.).
The Grape-bud Cut-worm	A.	cupida Grote.
The W-marked Cut-worm	A.	elandestina (Harris).
The Dark-sided Cut-worm.....	A.	messoria Harris.
The Striped Cut-worm	A.	tessellata Harris.
	A.	declarata (Walk.).
The Cabbage Cut-worm.....	A.	annexa (Treits.).
The Shagreened Cut-worm	A.	malefida (Guen.).
The Black Cut-worm.....	A.	ypsilon (Rott.).
The Variegated Cut-worm	A.	saucia (Hüb.).
The Grass-green Cut-worm.....	A.	lubricans (Guen.).
The White-bristly Cut-worm.....	Mamestra	renigera (Steph.).
The Speckled Cut-worm	M.	subjuncta (Gr.-Rob.).
The Clover Cut-worm.....	M.	trifolii (Rott.).
The Yellow-headed Cut-worm	Hadena	arctica Boisd.
The Glassy Cut-worm.....	H.	devastatrix (Brace).
	H.	lignicolor (Guen.).
	H.	sputatrix Grote.
The Army Cut-worm.....	Laphygma	frugiperda (Sm.-Abb.).
The Wheat Cut-worm	Prodenia	commelinæ (Sm.-Abb.).
The Bronze-colored Cut-worm.....	Nephelodes	violans Guen.

In a revision of the present paper, it is proposed to notice each of the above species in some detail, presenting figures (of many), their synonymy and references to publication, descriptions of the caterpillar and moth, habits, time of appearance, and geographical distribution.

The following species, there is reason for believing, may be added to the above list, when their larval habits are ascertained:

Agrotis Normaniana Grote.	Mamestra confusa (Hüb.).
Agrotis alternata Grote.	Mamestra lorea (Guen.).
Agrotis prasina (Fabr.).	Luceria passer (Guen.).
Mamestra mucens (Hüb.).	Hadena apamiformis (Guen.).

Hadena verbascoides (Guen.).

Hadena finitima (Guen.).

H. *cariosa* (Guen.).

Hyppa xylinoides Guen.

H. *sectilis* (Guen.).

Helotropha reniformis Grote.

H. *vulgaris* (Gr.-Rob.).

Apamea nictitans (Linn.).

NATURAL ENEMIES.

As would naturally be expected from their numbers, their size, and their smooth bodies, the cut-worms have many natural enemies, whose persistence in seeking for them and making them their prey, greatly mitigates the injuries that their unchecked increase would otherwise inflict upon us. Of these, only a few will be referred to in this paper.

The nocturnal habits of most of the species render them much less liable to become the prey of our insectivorous birds than those that feed by day without concealment, yet they are far from enjoying entire immunity.

The Robin. — Foremost among the birds as a cut-worm destroyer, the robin (*Merula migratoria*) claims position. Mr. F. H. King, in his *Economic Relations of Wisconsin Birds*, forming chapter xi of vol. 1 of the *Wisconsin Geological Survey* (1883), has written as follows of it :

"Its eminently terrestrial habits, its fondness for larvæ of various kinds, and its ability to obtain those which are hidden beneath the turf, give it a usefulness in destroying cut-worms which no other bird possesses in the same degree, and for this feature in its economy alone, its greater abundance should be encouraged.

"Early in the morning, and toward the close of the evening, the Robin may often be seen searching after cut-worms in lawns, pastures and meadows, and when thus engaged, it hops about gazing apparently more at distant objects than searching for something near at hand; then, suddenly, it commences tearing up the old grass and turf with its bill; and, in another instant, it stands triumphant with its wriggling prize in its bill, for it rarely digs in vain. I have seen a Robin capture in this manner five cut-worms in less than ten minutes; and five other birds within view were doing the same work. * * * How the Robin discovers these cut-worms is not easily explained. It is possible, however, that the larvæ, while gnawing at the bases and roots of the grass stems, while secreting themselves after their night's raids, or while, toward evening, they grow restless and hungry, the slight movements which they produce among the grass are sufficient to betray their

hiding places to the Robin. It should be observed in regard to these cut-worms, that large numbers of them are destroyed by various birds just after showers and during cool, drizzly and lowery days, when the absence of the scorching rays of the sun, enables them to feed with quite as much comfort as during the night.

"From the stomach of one Robin were taken seven cut-worms, 1.25 inch long."

Prof. Forbes, State Entomologist of Illinois, in the examination of the contents of the stomachs of nine Robins, made during the month of May, found that cut-worms were extraordinarily prominent in their food, making twenty-eight per cent of the whole. Half of them consisting of a single large injurious species, *Nephelodes violans* (*Bulletin No. 6, Illinois State Laboratory of Natural History, 1882, p. 4*).

The Cat bird.—The same food has been found in the stomach of this species, *Mimus Carolinensis* L. (*id., ib.*).

In the examination of the stomachs of several young Cat-birds, Mr. C. M. Weed determined sixty-two per cent of the contents to be larval noctuids, and mainly of cut-worms (*Note from the Entomological Laboratory of the Michigan Agricultural College, 1884, p. 21*).

The Red-winged Black bird.—Prof. Forbes has also taken cut-worms from the stomach of this bird, *Agelaius Phoeniceus* L., in Illinois.

The Purple Grackle.—Mr. King notes of this Grackle, *Quiscalus purpureus*, that it often follows the plow in quest of grubs and cut-worms (*loc. cit., p. 552*).

Poultry.—Chickens, especially, are very efficient destroyers of cut-worms, in gardens, where they search for, and are quick to discover, them in the upturned ground. A large orchardist has stated that he would not have been able to cope with the worms that attacked his trees without availing himself of the services of a large brood of chickens procured for the purpose (*First Report of the Insects of Missouri, p. 90*).

Calosoma calidum (Fabr.).—The larva of this ground-beetle, previously referred to on page 19, which preys upon many

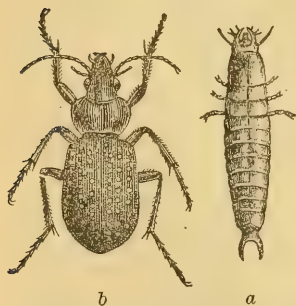


FIG. 25.—*CALOSOMA CALIDUM*: of this ground-beetle, previously referred to on page 19, which preys upon many

different species of caterpillars, is so destructive to cut-worms, attacking them with so much energy, even if the worm be twice its size, that it has been designated by Dr. Shimer as the "Cut-worm Lion." Figure 25 represents the insect at *a*. For an interesting account of the operations of this powerful and ferocious larva, in searching for the cut-worms that constitute so large a portion of its food, its manner of seizing the worm, and its subsequent combat with it, see Dr. Fitch in *Sixth-Ninth Reports on the Insects of New York*, pp. 249-250.

Harpalus caliginosus (Fabr.).—The larva of this species is also a persistent and efficient enemy. Its strange, irregular form and ferocious habits have given it, in some localities, the name of the "Cut-worm's dragon." "When not glutted with food, it is running about incessantly in search of these worms,

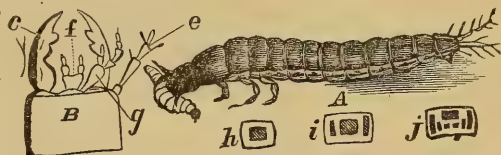


FIG. 26.—*A*, *Harpalus* larva, devouring a curculio larva. *B*, head seen from beneath, showing at *c*, the upper jaw (mandible); at *g*, the lower jaw (maxilla); with its four-jointed feelers (palpi); at *f*, the lower lip (labium), with its two-jointed feelers (palpi); and at *e*, the antenna; *h*, *i*, *j*, marks on the abdominal segments beneath. (After Walsh.)

and slays them without mercy, with its powerful jaws seizing them commonly by the throat, and regardless of their violent writhings and contortions, sucking out the contents of their skins" (Fitch). [Figure 26 represents the larva of a *Harpalus*—possibly of this species—in the act of devouring a curculio grub.] Others of the *Carabidæ* feed largely upon them. Professor Forbes has found the remains of *Agrotis annexa* Treits. in the stomachs of *Pterostichus permundus* (Say), *P. Sayi* Brullé, and *P. lucublandus* (Say), and remains of undetermined species in *Chlænius erythropus* Germ., in the proportion of one-third of the entire contents (*Twelfth Report on the Insects of Illinois*, 1883, pp. 110, 111).

An undetermined species of insect—"somewhat resembling the black wasp, but longer, shaped somewhat more like the hornet, but of a shining black," has been observed eagerly searching for the worms, even digging for them in the soil with its front legs, and drawing them forth, and stinging them fatally. Leaving them to die, it would subsequently return and excavate a hole in the ground in which to bury them, and heaping a mound over them (*Albany Cultivator*, vol. v, p. 18).



FIG. 27.—*PODISUS SPINOSUS* (Dallas). *a*, the beak or proboscis enlarged; *b*, the insect, with one wing extended.

Podisus spinosus (Dallas).—This carnivorous Hemipter, known from its belligerent propensities as the “spined soldier-bug,” will fearlessly attack young cut-worms much exceeding it in size, and take their lives by sucking their juices through its formidable proboscis—shown in enlargement in Figure 27.

Uropoda Americana Riley.—Prof. French has observed this mite preying upon the Variegated cut-worm, while tightly fastened to it by means of a peculiar stiff, elastic pedicel or cord proceeding from the anal portion of its body, which Dugés has thought to consist of the viscous and dried excrements of the animal (*7th Rept. Ins. Illinois*, p. 218, and *Murray's Economic Entomology*, p. 163).

Spiders are also known to attack and kill cut-worms in their immature stages of growth.

The Toad.—Mr. Wm. Brodie, of Ontario, regards the toad as deserving of protection and introduction into gardens from its habit of coming abroad at night and devouring the cut-worms which are then seeking their food upon or near the ground.

Mr. E. W. Allis, of Adrian, Mich., reports his having taken on June twelfth thirty-three cut-worms from the stomach of a wart-toad, *Bufo Americanus* (*Thirteenth Report State Horticultural Society of Michigan*, 1883, p. 16).

PARASITES.

The partial immunity of cut-worms from destruction by such of their natural enemies as are above mentioned, resulting from the concealment in which the larger part of their lives are passed, attends them also in preserving them, to a great extent, from the attack of those parasitic foes which serve so important a purpose in diminishing the numbers of our insect pests. Yet, as the white grub, *Lachnosterna fusca*, is pursued and discovered in its subterranean burrows by its enemy, *Tiphia inornata*, and as *Tremex columba* falls a victim to the *Thalessas*, although deeply buried within the trunk of maple, oak or elm, so, also, are these nocturnal marauders of our gardens and fields compelled to succumb before the fatal thrust of the ovipositor of their commissioned parasitic foes.

As few, however, of the cut-worms have been studied during their larval stage, we know, as yet, almost nothing of the extent to which they are parasitized, or the names of the species that prey upon them. One of the species, *Nephelodes violans* Guen., studied recently in connection with its appearance in remarkable numbers in St. Lawrence county, N. Y., was found to be very subject to parasitic attack. Larvæ that I attempted to rear gave me many Tachinid puparia and two different hymenopterous pupæ (1st Rept. Ins. N. Y., 1882, p. 109). Prof. Riley states of the same larvæ: "Of nineteen specimens placed in a vivarium * * * several proved to have been parasitized; one had nineteen *Tachina* eggs upon it [after the manner shown in Figure 28]; another gave forth *Microgaster* larvæ, which had spun their white cocoons in a surface cavity in the ground made by the larva, and still another gave an *Ophion* cocoon" (ib., p. 103). Of other species, Mr. William Saunders has written as follows: "Cut-worms have been very abundant in the neighborhood of London during the spring [of 1880]. * * * When I reared a number of the larvæ with a view of breeding the moths, I found them so affected with parasites that I did not get a single moth, so that, although the larvæ were exceedingly abundant, the moths proceeding from them were comparatively rare, and all through the agency of the parasites" (*Ontario Agricultural Commission Report*, 1881, p. 219).



FIG. 28.—*NEMORÆA LEUCANIÆ*; the larva, fly, and puparium; also, its eggs placed upon the forepart of an army-worm, on which it is parasitic.

The following parasites are reported by Professor Riley as having been obtained by him: *Paniscus geminatus* Say—a large, yellowish-brown Ichneumon fly—its source not stated; *Nemoræa leucaniæ*, Kirkp., shown in Figure 28, from *Laphygma frugiperda* (Sm.—Abb.); and *Tachina archippivora* Riley, from an unknown cut-worm resembling that of *Agrotis subgothica* (Haworth).

Another *Tachina* fly was bred from the Black-lined Cut-worm, *Agrotis fennica* Tausch., during its recent abundance in Northern Michigan (in the months of April and May, 1884), and has been named and described by Dr. Williston as *Scopolia sequax* (Cook's *Notes on Injurious Insects—Entomolog. Laboratory, Mich. Agricul. Coll.*, 1884, pp. 5–6, figs. 5, 6).

Mr. Jno. G. Jack, of Chateaugay, Quebec, has reared from a dead cut-worm (species unnamed) a large number of minute Hymenopterous parasites, belonging to the *Chalcididae*, which he has identified as *Copidosoma truncatellum* Dalman, a figure of which is given in the Report of the Commissioner of Agriculture for 1883 (Report of the Entomologist), pl. xi, figure 6 (*Canadian Entomologist*, xviii, 1886, p. 23).

Another chalcid parasite, *Copidosoma celenæ*, has been described by Mr. L. O. Howard (*Bull. No. 5, Bureau of Entomology—U. S. Dept. Agriculture*, 1885, p. 11), as having been reared, in the female only, in large numbers, from *Mamestra renigera* Steph., collected as St. Louis, Mo.

PREVENTIVES AND REMEDIES.

Quite a large proportion of the voluminous literature of cut-worms to which we have referred, as distributed throughout our agricultural journals, consists of methods of prevention and remedy, almost every one of which we are asked to accept as effectual, and very many of them as "superior to all others." And still the cut-worm remains with us and obstinately refuses to be exterminated.

It is not the purpose of this paper to present a compilation of what has been written upon the subject, but rather to give an abstract of what is known upon it. Nothing, therefore, would be gained by referring to the many remedial measures proposed which have not stood the test of experiment, or to those which do not give promise of accomplishing the desired results inexpensively and with that amount of labor which can easily be spared from the other pressing duties of the opening agricultural year.

The following are some of the methods that we deem the most valuable:

Salt.—A correspondent of the *Country Gentleman* [E. H.], from Chester, Pa., gives the following method of protection by the use of salt, which, after having tested its efficacy for several years, he pronounces "cheap, of easy application, and perfectly sure:"

"Immediately after the corn is planted, sprinkle on the hill over the covered grains, about one tablespoonful of common salt to each hill."

The explanation given for the protection of the plants is, that the salt as dissolved by the rain, dew or other atmospheric moisture, is carried down to the roots and taken up by them into the circulation; and that although salt in itself will not injure cut-worms even

if they be buried in it, they will not eat young corn if there is a little salt in its sap.

Should the salt not be applied until after the corn has shown itself above the ground, it might kill the plants: applied as above directed, it will do no harm. (*Country Gentlemen*, for Feb. 27, 1873, p. 132, c. 2-3.)

Another method of protection with salt is said to be, to soak the seed corn in a strong brine for twenty-four hours before planting. It is asserted that it prevents it from being eaten in the ground, and hastens its germination by from one to two days. This may prove to be quite as effectual in protecting from cut-worm as the application of salt upon the ground.

A writer in the *Rural New Yorker* (Feb. 18, 1888, xlvii, p. 108) prevented injuries to corn, in a field which upon plowing he found "alive with half-grown cut-worms," by sowing broadcast over the field, the day after its planting, 250 pounds of salt to the acre. Not a single hill was cut by the worms.

Copperas.—The publication of the first of the above methods called out the following, which the writer thinks "is more easily applied and equally effective," as it had been employed by himself and others for twelve years, and always with success, even upon new ground and clover land. It had been tested by planting portions of fields without the preparation, and these portions, in several instances, required replanting two or three times:

"Put the seed corn in a tight tub or barrel, and pour in enough water to keep it well covered after it swells. For each bushel of corn add a pound or a pound and a half of copperas dissolved in warm water. Stir well, and allow the corn to remain in the copperas water twenty-four or thirty hours. Stir several times while soaking. Then take out and sprinkle a small quantity of land-plaster over — enough to prevent the grain from sticking together — and plant. When prepared as directed, if a change should occur in the weather to prevent planting, the corn may be spread out upon a floor and allowed to remain until good planting weather. It will turn black in drying, but that does not matter" (*Country Gentleman*, for March 20, 1873, xxxviii, p. 179, c. 2-3).

Saltpeter.—A saltpeter solution has been recommended for pouring about the roots of plants infested with cut-worms. It is said to kill the pests while at the same time it operates as a nitrogenous fertilizer, aiding the plants to resist attack.

Hellebore.—An experiment with hellebore dissolved in water has proved entirely successful in protecting young tobacco plants from the worms. A writer from West Meriden, Conn., gives this satisfactory account of its use :

“On Tuesday, June 22d, we set three thousand plants, and on the next morning I took from one row of one hundred and eighty plants, two hundred and fourteen cut-worms, and on the same day, in the same field, I set twelve plants dipped in a solution of white hellebore, and to this time they remain untouched, while the plants in the rows on either side are more than half destroyed. June 24th we set over two thousand plants treated in the same manner, and I find only one plant eaten, and that slightly. The plants are not injuriously affected by the treatment. On plants already set, sift the powder from a muslin bag, and I am told they are protected perfectly. It appears to be a specific for the cut-worm. We use one-quarter of a pound to ten quarts of water” (*Count. Gent.*, for July 8, 1875, p. 425).

Coal Oil.—Not only is the odor of this substance serviceable in preventing attack, but the oil is also an insecticide. It could be mixed with dry sand and scattered around the plants to be protected, as for example, a tablespoonful about a cabbage or tomato plant. To check the depredations beneath the surface or to destroy the larva hiding there, it might be necessary to use it in a larger quantity. A teacupful of the oil (kerosene) to a pailful of sand has been recommended, to be renewed each week during the presence of the worms. A larger proportion of the oil might safely be used—a sufficient quantity to moisten the sand to a degree not preventing its running readily through the hand when distributing it.

Cultivation of sod-land.—It is claimed that where land is not allowed to lie in sod for over two years at a time, cut-worms will not accumulate in it, and consequently corn planted upon it when broken up suffers much less from attack.

Thick planting.—Planting more seed than is needed for maturity has frequently been found of service. When the larvæ are not numerous, two or three stalks of corn or beans may suffice them to complete their growth when near their pupation and the attack is late. Although the labor of subsequently thinning by hand is saved, the policy can not be recommended, as the relief obtained is but temporary, for the numerous progeny of the larvæ which you have helped to mature, may the following season require for their needs every stalk in a hill.

Late plowing.—A gentleman from Chautauqua county, N. Y., states, from the result of forty years experience, that plowing the ground late in the autumn or in the winter, if there is hard freezing afterward, will certainly destroy the cut-worms (*Count. Gent.*, for Feb. 29, 1874, p. 71).

The efficacy of such late plowing has been affirmed by many writers, and has also been presented in some of our entomological reports as one of the best of remedies. That it has not always been attended with success (see *C.-G.*, for March 5, 1874, p. 147, where the method is said to have failed entirely), may be accounted for by its not having been done at the proper time.

The plowing should be deferred until the cut-worms have become torpid, and it should be sufficiently thorough to crush the cells that they have shaped for their winter's sleep. These cells are believed to be essential to their survival of the winter. Within them, curled in a ring, and in such a position that the smallest possible portion of their surface (a single point only upon a few, not all, of their rounded segments) is in contact with the ground—they undergo freezing, perhaps alternate freezing and thawing over and over repeatedly, with impunity.

Under different conditions—with the soil enveloping them, resting upon and adhering to their entire surface, covering their breathing-pores and working within the joints of their abdomen—it would indeed be a marvel if the rigors of winter should not prove fatal to them. The entomologist knows how important it is that the cell shaped by the caterpillar for its pupation, in carefully prepared ground, for its three or four weeks occupancy in the summer, should not be destroyed if he would succeed in obtaining the moth for his cabinet.

Late plowing in the spring, just before a late planting, has also been recommended for infested sod-land, upon the theory that the cut-worms will have fed to maturity upon the sod, leaving the corn to spring up untouched, and with a more vigorous and healthful growth in the warmer soil and temperature of the advanced season.

Tin Bands.—A simple, cheap and permanent device for protection of single plants, is this: A strip of tin two inches wide, ten inches long, bent into the form of a cylinder, with a narrow lap at each end so as to hook together. The following is given in its favor:

“It works to a charm; no cut-worm ever goes over it; it can be hooked together and put over a plant, and remain there until the

plant is out of the way of the worm, then it can be unhooked and put away for another season. The inside should be painted, as the bright tin when new will concentrate the rays of the sun and burn the plant. They cost about \$1.50 per 100, and will last a long time, if painted" (*Country Gentleman*, for May 31, 1877, p. 348, c. 1).

Paper Frames.—A writer gives this method for protecting from cut-worms in a garden or patch: "Prepare at leisure a quantity of small paper boxes—say from four to six inches square, without bottom or top, made to taper about half an inch. Place these around the plants, the widest part up, so that the worms can not crawl up their sides. Dipping the boxes in a strong solution of shellac will, with care, make them last for years."

Paper Wraps.—The bands and frames above mentioned can only give protection against those larvæ that feed above ground. A simple device, involving no expense and hardly any labor, often employed by gardeners to protect cabbage and tomato plants from the species that sever the stalks below the surface, is that of wrapping a piece of rather thick paper around the stalk as the plants are set in the ground. Allowing it to project a little distance above the ground may also circumvent the surface feeders. A burdock leaf, or some other leaf of sufficient size, is sometimes used instead of the paper.

Clover Traps.—Mr. T. Boynton, of Michigan, states that he has been very successful in entrapping cut-worms by placing wads of clover among his tomato plants. The worms would gather about them during the night, eat what they wanted, and secrete themselves in the earth close by, not over six feet distant. As many as eighty-two worms were found in the neighborhood of one of these balls of hay [made of about the size of an apple]; in another instance, seventy; in another, sixty-eight. On June fourth he claims to have destroyed over 15,000 of these worms, which were on and about his clover balls, by using boiling water. When the worms chance to be even slightly protected, nothing less than water boiling hot will kill them (*Country Gentlemen* for June 27, 1872, p. 409, c. 1).

An improvement upon this method has been recommended by Prof. Riley, the publication of which is made as these pages are to be handed to the printer (*Ann. Rept. Depart. Agricul.*, for 1884, pp. 299, 300). It is the poisoning of the bait to save the labor of collecting and killing the larvæ by the hot water, or otherwise.

Prof. Riley states: "We used chiefly clover sprinkled with Paris-green water and laid at intervals between the rows, in loosely-tied masses or balls, which served the double purpose of prolonging the freshness of the bait and of affording a lure for shelter." A modification of the method, employed by Dr. Oemler, of Savannah, Ga., was that of preparing cabbage or turnip leaves by dipping them in a well-stirred mixture of a tablespoonful of Paris green to a bucket of water, or sprinkling the side next the ground after first moistening with a mixture of one part of Paris green to twenty of flour, and placing them at distances of from fifteen to twenty feet throughout the field to be protected. Two applications of this character at intervals of three or four days, particularly in cloudy weather, were usually successful in ridding the field of the pest.

Trapping in holes.—An old method which is occasionally noticed as attended with good results, is that of making several holes a few inches deep about the hills, with a tapering stick to compress the earth at the sides, into which the worms would fall and be unable to crawl out. It is stated that in some instances where this has been resorted to, some of the holes were found to have been half-filled with cut-worms during a single night. They could be killed by reinserting the stick, or left to die, or to devour one another as some of the species are known to do when the opportunity offers in the absence of other food.

Digging out.—The recommendations of digging out and destroying the cut-worms when the plants are seen to be cut off by them, doubtless seems a poor remedy to those who have never tested it—as requiring too much valuable time and labor, and therefore, not available when large fields are to be protected. Its rejection or even its non-acceptance should not rest upon a mere prejudice against it, for if proven to be both practicable and effectual, it can not fail of being one of the best, if not *the best* of methods of dealing with this pest, for this simple reason: Many other methods merely prevent the feeding upon the protected crop, but leave the hungry creatures free, with appetites sharpened by delay, to attack and destroy other and often more valuable crops. With a cut-worm dug out from its retreat beside a wilted plant, and killed, there is this satisfaction, not only that its career for further harm is ended, but that it will not develop into a moth containing within its abdomen two hundred or more eggs, each of which would later produce a cut-worm.

Is the digging-out method practicable on a large scale, and will it give the results desired? An "Old Farmer" writes as follows of it, after premising that he had made a faithful trial of many remedies, but was now employing this in his corn-field, and that it was adopted, so far as he knew, by all good farmers.

"I have six acres of corn planted on sod which was turned over from a pasture just before planting. By the time it was up, the cut-worms made their appearance by hundreds, and my hired man was alarmed. 'All right,' said I, 'I am ready for them.' I set my two men at work on them, making regular days work of the business. Taking a row at a time, and digging down wherever a corn-plant was cut off, they went over the field in about half a day, killing over fifteen hundred. A few days later, they went over again, and did not get quite so many. I had the corn planted rather thick, and the plants which the worms took could be spared. At the third hunt, when the corn was about as large as the worms could manage I directed the crop to be regularly and evenly thinned, at the same operation. I have saved my corn, and have a handsome and even field. Had I let the worms have their way, I should certainly have lost half. I once lost over three-fourths. I have spent three days work in this way, worth \$4—and I have saved by the operation at least one hundred bushels of corn on the six acres; more probably one hundred and fifty. *I think it pays!*" (*Country Gentleman* for June 14, 1877, p. 376.)

The letter states that the cut-worms destroyed, were "the plump brown grub that cuts the corn off just below the surface."

Another species of cut-worm differs in its habit of feeding from the above, in that it cuts the corn off just *above* the surface of the ground. It is this species which is referred to by Mr. Armstrong, secretary of the Elmira Farmers' Club, in his commendation of the digging-out remedy. He writes:

"There is really but one way to save the crop after the plants are once attacked by cut-worms—that is, to dig the worms out and kill them. It is not a difficult task, nor is it very costly. I presume that a fourth part of the loss sustained, would be a full equivalent of all the labor it would cost. The worm does the mischief at night, and before morning burrows in the ground near the spot where its depredations have been committed. A practiced eye will readily discern the entrance to the hiding-place into which the

worm has passed and lies concealed. The way to bring the pest up is to thrust a pointed knife down near the hole and lift out the earth to the depth of two or three inches, when the malefactor will lie exposed to view, and can be instantly destroyed. I have known large fields to be cleared by this process at a cost of labor so slight as to bear no comparison with the loss that would have otherwise resulted" (*Country Gentleman* for Jan. 6, 1881, p. 8).

The idea has been advanced that dandelions (*Taraxacum dens-leonis*) foster the cut-worm, and if these were carefully cut up whenever seen, its injuries would be greatly mitigated (*Country Gentleman*, June 20, 1872, p. 392, c. 2). Examinations about the plants during the month of June, would show if there is reason for this belief.

Starvation. — An instance is related where cut-worm attack was forestalled by removing their food-material from the ground. A piece of sod was turned over before the grass had made much growth. It was dragged, to bring up the roots and dry them. A week later, another dragging was given it, which destroyed every green thing. It was then planted with corn, and entirely escaped the usual cut-worm attack (*Country Gentleman*, May 6, 1875, p. 277, c. 1).

This method can not fail of being as effectual against cut-worms as for destroying the white grub, for which, in a former paper, I have strongly recommended it.

TWO PREVENTIVES SPECIALLY COMMENDED.

It will be observed that quite a number of preventives and remedies have been given above, and it may be asked why this is so frequently done in our entomological writings. We reply: A method adapted to the soil of one locality may not be as effectual in another; it may be more difficult of application in one place than in another; it may be available for garden use, but not for the more extended area of field and farm; it may require to be thoroughly tested before its real merit is known and it can be urged to the exclusion of others.

It would seem, however, that we have in the above, two preventives for cut-worm attack in corn fields, either of which may be relied upon for general use. We speak thus strongly in their favor, in consideration of the tests made of their efficacy, as in the statements subjoined. Of the protection by salt, Mr. J. L. du Fief, of Montgomery county, Maryland, writes as follows:

"I tried the salt by selecting a piece of ground occupied for three years by a straw-rick, and upon which my cattle ran. After removing the old straw and manure and top-dressing the adjoining field, I selected this spot, as I had always found worms worse in such places. Immediately after planting the corn, I applied one table-spoonful of salt scattered over the hill. *Not a hill was touched by cut-worms, but all around this plot, where salt was not applied the worms cut two to three out of five hills, and we often found one to fifteen cut-worms in a hill, but none where salt was applied.*"

Mr. du Fief also bears testimony to the value of the copperas preventive. He gives his manner of preparing the seed-corn, which differs slightly from that stated above mainly in time of soaking.

"I pulverized two pounds of copperas at night, and the next morning put in soak, and I put one and a half bushels of corn in soak in a separate vessel at night. After soaking twelve hours, I poured off the water from the corn into a tub; I then added as much water as will cover the corn, and add to it the copperas water, and thoroughly mix and pour over the corn, and let it remain in copperas water twelve hours; I then poured off the copperas water and rolled the seed-corn in J. J. T——'s Excelsior, or plaster."

Condensing his details — a forty-four acre field was planted in corn — first ten acres without the copperas preparation — next to it nearly ten acres with the prepared seed, and the remainder with unprepared — all treated alike, except the copperas application. He writes:

"To the surprise and satisfaction of myself and hands it [the prepared corn] came up regular, green and vigorous, and grew rapidly. I soon found it necessary to replant. I found, on examination, *not a hill cut or a worm to be found where the copperas was used*, and the entire field elsewhere cut from two or three hills out of five, with, sometimes, fifteen cut-worms in a hill."

The results, as obtained by his neighbors, as well as by himself, were pronounced most marked and astonishing (*Country Gentleman*, for April 23, 1874, p. 259, c. 3).

Mr. E. Harvey, of Chester county, Pennsylvania, confirms the efficacy of the salt application, as above directed (not applied to the blades of corn, which it will kill), based upon the results of a great many trials made by a great many different persons during the last fifteen or more years (*Country Gentleman*, for July 2, 1874, p. 419, c. 4).





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